M. Sc. DEGREE END SEMESTER EXAMINATION APRIL 2017

SEMESTER – 2: PHYSICS

COURSE : **15P2PHYT05; MATHEMATICAL METHODS IN PHYSICS – II**

(For Supplementary - 2015 Admission)

Time: Three Hours   Max. Marks: 75

PART - A

(Answer all questions. Each question carries 1 mark)

1. The locus represented by $| z-5-6i | = 4$ is a
   (a) Circle with centre (5,6) and radius 4 (b) Circle with centre (5,6) and radius 2 (c) Ellipse

2. If $\alpha, \beta, x, y \in R$ and $\sin(\alpha + i\beta) = x + iy$ then $\dfrac{x^2}{\cosh^2 \beta} + \dfrac{y^2}{\sinh^2 \beta} =$
   (a) 0   (b) = 1   (c) 2   (d) i

3. The Laplace transform of $e^{-at}(1\text{-}at)$ is
   (a) $\dfrac{s}{(s+a)^2}$ (b) $\dfrac{a}{(s+a)^2}$ (c) $\dfrac{s}{(s-a)^2}$ (d) $\dfrac{a}{(s-a)^2}$

4. Order of the differential equation $y = x\dfrac{d^2 y}{dx^2} + \left(\dfrac{dy}{dx}\right)^3$ is
   (a) 1   (b) 2   (c) 3   (d) 4

5. The number of generators of SU(3) group is
   (a) 3   (b) 10   (c) 8   (d) 9

                                                                                                (1*5=5)

PART - B

(Answer any 5 questions. Each question carries 2 marks)

6. Check whether the complex function $f(z) = \log_e(z)$ is analytic or not.

7. Evaluate using L'Hospital rule $\lim_{z \to 0} \dfrac{1 - cos z}{\sin z^2}$

8. What is the Laplace transform of a function f(t). Does Laplace transform exist for all functions? Explain.

9. Show that Fourier transform is a linear operation.

10. What are the conditions to be satisfied for a set (a, a^2, a^3, a^4) to form a fourth order group?

11. What is a Lie group? Give an example.

12. Give any two properties of Green's function.

13. What are the various types of partial differential equations?

                                                                                                (2*5=10)

PART - C

Answer any 3 questions. Each question carries 4 marks)

14. If $\omega = \varphi + i\Psi$ represents complex potential of an electric field and $\Psi = x^2 - y^2 + \dfrac{x}{(x^2|y^2)}$, determine the function φ

15. Find the Fourier exponential, sine and cosine transforms of $\dfrac{1}{(a^2+t^2)^n}$ for n = 2,3

16. Show that SU(2) is a 3 parameter group. Obtain the general form of SU(2) matrix
17. If every element of a group is its own inverse, then show that the group is abelian.
18. Find the Green's function for the boundary value problem $\dfrac{d^2 y(x)}{dx^2} + y(x) = f(x)$,

Y(0) = y'(1) =0

(3*4=12)

PART - D
(Answer all questions. Each question carries 12 Marks)

19. (a) Discuss the Laurent expansion of a complex function f(z) about the point z_0.

Expand f(z) = $\dfrac{1}{(z+1)(z+3)}$ as a Laurent series valid for IzI <1.

OR

19. (b) State and prove Cauchy's integral theorem and Cauchy's integral formula for the derivative of an
analytic function.

20. (a) (i) Solve the differential equation for the electric charge in a series LCR circuit using Laplace
transform?

OR

20. (b) Solve the differential equation for a harmonic oscillator using Fourier transform principle.
21. (a) If a matrix commutes with all the matrices of an irreducible representation, show that the matrix is a
constant.

OR

21. (b) What are various symmetry elements in a group of transformations? Discuss the condition for the
formation of a group by some symmetry elements.
22. (a) Derive and solve two dimensional heat flow equation.

OR

22. (b) Write Poisson's equation for electrostatic case. Discuss its solution using Greens function.

(12*4=48)

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